

Spark in Copper Furnace and Flame in Broad Market: Performance Modelling of Copper Futures and Nifty Spot for Intelligent Traders

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ABSTRACT

Copper, or Doctor Copper, is a barometer for industrial activities, but the big question is can it explain the movement of broader market. The NSE NIFTY index, or the NSE NIFTY 50, is a benchmark index for tracking the broader stock market in India. The stocks comprising of nifty 50 are powerful companies deriving maximum benefits from the booming Indian Economy. In fact, just these fifty stocks, out of some 1600 plus stocks listed at NSE, are responsible for over fifty percent of daily trading volume. Even, the entry barriers to these fifty companies are not so easy to overcome and it is a matter of prestige for companies to be featured in Nifty 50 Index. Also, volatility, which is a major concern for all investors alike, is among the lowest (12.1% for 2019) for Nifty Index if compared with all the major developed and emerging markets¹. The popularity of this index can be gauged from the fact that most of the ETFs listed on Indian bourses, the majority of them are based on Nifty 50, the only exception being gold ETF- which has been a traditional top investment choice for Indians. Among the scrips traded in India, Nifty Futures, based on NSE Nifty 50, is the most liquid in terms of bid-ask spread or the depth of the market. Copper, on the other hand, being a base metal used in various economic activities, is among the top ten traded contracts at MCX. Earlier papers on this subject have tried to establish relationship between the spot price and futures price. This paper is an attempt to fact check the performance of copper futures listed on MCX India, in general, and to check whether copper does influence at best, or contributes at a minimum, to the rally of NIFTY index. Earlier studies on copper futures were confined to relationships between spot copper price and futures price (Khan Ferojuddin M. A., Ramani L), general performance of commodity derivatives in India (Shaik Masood and T Satyanarayana Chary). A paper titled, 'A Study on Commodity Derivative Market of Selected non - agricultural Products (Gold, Crude Oil, Copper) in the Chennai Market- An Analysis' (Mr. P. Periasamy, Dr. R. Satish) tried to look for alpha in certain commodities. None of all these papers, however, have tried to establish linkages between one commodity (copper in our case) and broad market (Nifty, in our case). This study has tried to establish whether looking at the price pattern or behaviour of copper's price indicated by Copper Futures can someone gauge the movement of broad market index like India's NSE Nifty which is an index of 50 most liquid and the largest cap stocks. So, the current futures price of Nifty is a dependent variable and price of copper futures is independent variable. Data for our study has been taken from exchanges website; for copper futures-near month's future price from MCX India website; for Nifty spot – data from NSE India has been taken. Almost seven years of daily data has been used for the purpose of this article and we have tried to see whether on daily basis, lagged daily basis, weekly basis, lagged weekly basis, monthly basis is there any predictive

relationship between copper futures price and price of NSE Nifty 50 Index. For the purpose of study various statistical tools like, correlation, regression, Unit root test, ANNOVA, etc are applied. The results show that daily returns, weekly returns of copper futures are not significantly correlated with corresponding figures for NIFTY. Even the lagged return of NIFTY is not correlated with return on copper futures. The study reveals significant, albeit low, correlations between monthly return of copper futures and monthly NIFTY return. The volume in copper futures, and even the liquidity, is nowhere comparable with the volume and liquidity of NSE Nifty, hence, it appears that copper is still not as crowded as the broader stock market, especially NSE Nifty. Hence, it is possible to beat market simply by investing in copper futures on the basis of Relative Strength Indicator (RSI) – a momentum indicator that tells when market is oversold and hence to buy and when market is overbought, hence to sell. Our results show that it is very easy to make profit in copper futures trade, however, the same is not possible with stock market index. NIFTY with a history of approximately a quarter century behaves like a big brother to copper which has miles to go as far as market maturity is concerned.

Keywords: Copper futures; NIFTY, Correlations, Monthly Return; Relative Strength Indicator (RSI); Trading signals

JEL Code: C87; G13; G14.

INTRODUCTION

Copper, or Doctor Copper, is a barometer for industrial activities. Being an industrial metal, it is used almost everywhere from phone charger, cable, chips to mobile phones and many other electronic as well as auto parts. The world is going green as is evident from the record performance of Tesla Motors in USA and going forward green is the only way out. Therefore, it won't be overstatement to say that the shine of this metal is not going to lose lustre anytime in near future. Notwithstanding the importance of copper in industrial activities, it being a commodity, the demand for it and even the supply of this metal is likely to be cyclical. Trading hours of copper, and also of other commodities, in India is spanned around 14 hours during a day to match with international commodity market trading. The normal equity and equity derivatives markets in India, however, is open only for six hours¹. The equity market in India is tracked globally by institutional investors across continents, both for return enhancement and risk reduction. Two indices, NSE Nifty and BSE Sensex are very popular both for tracking the performance of broader market and also for hedging. Commodities in general are expected to exhibit momentum strategies, however, in case of equities the bull run can sustain for much longer – the recent case of bull run in US equities market since 2009 is a case in point.

Futures contracts on individual stocks, commodities, indexes, etc. have different lot sizes in different jurisdiction. Copper Futures, for example, has a lot size of 25 tons at LME, 5 tons in China and only 2.5 tonnes at Indian commodity exchanges. As a general rule of thumb, regulators have tried to keep small investors out of speculation, hence, the entry barriers to trade in derivatives contracts are different in different jurisdiction. As we have pointed out, copper futures is one of the most actively traded futures contracts in commodities derivatives market in India, hence, its comparison and consequently its influence on broad market is a fair attempt in understanding any link between a widely used commodity and the broad stock market. Sensex 30 is also a very good index and, in fact, is much older in terms of existence. However, for comparison purposes, we have decided to use Nifty index instead of Sensex, primarily because of the liquidity of the Nifty Futures contract. The daily volume of Nifty Futures at NSE is almost equal, on average, to daily trading in equity cash market. On any particular day, the average traded value of Nifty Futures is between USD 5 billion to 10 billion. With so much of liquidity in one specific contract, the price discovery is bound to take place at much more rapid pace than in case of other less liquid contract. Although there are six commodity exchanges in India, the majority volume in case of futures trading in metal is with the Multi Commodity Exchange of India (MCX). And, this is the reason, we have selected copper futures price quoted at MCX India. The NIFTY index, or the NSE NIFTY 50, is a benchmark index for

¹ With the launch of two exchanges at Gandhinagar at Gujarat International Financial Services Centre (GIFT) City, the Indian derivatives markets is open for almost twenty-two hours. This market, as on date, however, is not open to resident Indians.

tracking the broader stock market in India. Created in 1996, this index has participation from 13 sectors of the Indian Economyⁱⁱ. It represents almost two third of free float market capitalization of all the stocks listed on National Stock Exchange of India Ltd (NSE). Hence, any move in NIFTY should be an indicator of the mood of the market about Economy. Financial Services, at 38.85 percent, has the highest exposure to this index².

In the last nineteen years, the price of copper has jumped four folds, whereas the NIFTY index has moved to more than 13 times. This simple result could be a reminder that return on a commodity, copper being the instant case, would not match the return of a broader market (say NIFTY) over a longer period of time. In short term, however, anything is possible. In many countries, India included, Regulators artificially create opportunities that can be exploited using intelligent software or models. For example, Securities and Exchange Board of India (SEBI) – the market regulator for both equities, commodity derivatives, till recently did not allow large funds to trade in commodity derivatives. It was only in the year 2019 that mutual funds were allowed to invest in commodities, however, we have not seen any funds coming with New fund offers marketing commodities as one of the products. Most of the investments of mutual funds in commodities is seen in case of Gold only. For hedge funds too, the journey has not steamed off yet, though they were allowed to invest in commodities way back in 2017, some road blocks that remained was cleared in 2019ⁱⁱⁱ. A situation like this is very easy to favour smart traders/businesses using simple, yet sophisticated systems to exploit the inefficiencies that exist in this kind of market. This paper is an attempt to fact check the performance of copper futures listed on MCX India, in general, and to check whether copper does influence at best, or contributes at a minimum to the rally of NIFTY index. Also, using any intelligent systems/models, can anyone exploit the hidden abnormal return with minimal effort?

LITERATURE REVIEW

There have been studies on information flow to spot and futures market and whichever market captures the information is supposed to be more efficient. Markets for different commodities are differently integrated across spot and futures market. Kenneth D. Garbade and William L. Silber, in their article published The Review of Economics and Statistics, May, 1983, Vol. 65, No. 2 concluded that information flow is faster in Gold and Silver compared to the market for Agri commodities. Ari Levine, et al (Financial Analysts Journal, 02 April 2018, Volume 74 Issue 2) using data sets from 1877 onwards show that in the long run returns of commodity futures indices, on an average, are positive. According to GERAL R. JENSEN, et al, people invest in commodities due to expected appreciation and a form of portfolio insurance^{iv}. Precious metals used in combination with large indexes such as NSE Nifty or S&P 500 have been found to be effective in hedging^v. Benefits of investing in commodities are available with investment in commodity futures, however, emerging markets are no substitute for commodity investing, finds Timothy Atwill, CFA^{vi}. Geetesh Bhardwaj, et al finds that investing in monthly commodity futures gives return similar to long term average commodity return^{vii}. In a study on use of commodity futures alongside a portfolio consisting of equity, Robert T. Daigler, et al. finds that commodity adds to mean variance optimal framework, both natural gas and copper futures returns during the period under study have been found to be the highest. These portfolios also exhibit lower tail risk^{viii}. In an article published in 2014 by M. Ferojuddin, et. al, using spot price and futures price at MCX India, the authors found direct correlation between spot price and futures price. However, the relationship was lost between non-stationary spot and futures price and when data changed to stationary the relationship was not so close. In an article published in 2018, Hariharan, R, et. al, the authors, using volatilities tools, found that the important factors affecting prices of commodities on exchanges are the demand for and supply of the crop, the prevailing weather conditions, substitution effects, consumer preferences, etc. Marat Molyboga, Junkai Qian, and Hauhau He in their article titled, 'Carry and Time Series Momentum', published in 2020, found that what contributes maximum value in economic and statistical terms during the periods under study was the conditioning of time-series momentum. And, these periods were associated with high marginal utility of investors. In an article titled, 'Performance of Commodity Derivatives in India', published in the year 2016, Masood Shaik and T. Satyanarayana Chary, inter-alia, found that the growth between

² Source: www.nseindia.com, the data is as at the end of March 31, 2019.

volume and value is non-linear to the extent that their estimated and actual growth is concerned. The variance between the volume and value of the market followed a reciprocal trend. Using three day's moving averages, Prashanta Athma, K.P. Venu Gopala Rao found that the markets are efficient and availability of Comdex for trading can enable the market participants to hedge their risk on a larger canvas. This article studied the temporal relationship between the spot price and the futures prices in India's Multi Commodities Exchange (MCX). Using Simple Moving Average (SMA), Relative Strength Indicator (RSI), Moving Average Convergence and Divergence (MACD), Exponential Moving Average (EMA), Rate of Change (ROC), P.Periasamy, Dr. R. Satish, in an article titled A Study on Commodity Derivative Market of Selected Non-Agricultural Products, found that an investor can succeed in his investment only when he/she is able to select the right commodities at right time. The investors should keenly watch the situation like market price, economy, returns, and the risk involved before taking decision on a particular commodity. The right investment selected by an investor can enable him/her success at the right time. Things to watch out for an investor is, market price, economy, returns, risk, before taking any investment decision on a commodity. Using data from LME for copper futures prices, Dimitris Kenourgios and Aristeidis Samitas, in their article published in 2010 found that the market is not efficient and do not provide unbiased estimates of future copper spot prices, which has important implications for the users of this market. Working on momentum strategy in commodity futures, the duo of Joëlle Miffre and Georgios Rallis Cass found that in a well-diversified portfolio inclusion of commodity futures adds further to the strength of the portfolio. Also, there is low correlation between the momentum returns and returns of traditional asset classes. The purpose of this article was to test for the presence of short-term momentum and long-term reversal in commodity futures market. Using empirical evidences and the information from copper prices in Chinese markets and other leading markets of copper productions, Rutledge, Robert W, et. al found a long-term price relationship with all its participants which may have implications for the countries to argue for more power over the price discovery process for copper contracts. The authors intended to establish linkages between world's three leading copper futures market. Using causality tests, Kentico Aruga and Shunsuke Managi, in their 2012 paper captioned 'Price Linkages in the Copper Futures, Primary, and Scrap Markets', concluded that the futures market plays an important role in price transmission of copper markets whereas such information flow is not established for scrap brass market.

RESEARCH GAP

A lot of study has been conducted to find relation between Commodity market and Stock market. Returns from international commodity markets are also compared with Indian commodity market but impact of copper futures on NIFTY spot returns is not studied till now. Ideally, copper futures should have been compared with NIFTY Futures, however, the data for NIFTY futures for such a long period is not readily available on exchange's (NSE) website, hence, NIFTY spot, which we feel is a very good proxy for NIFTY futures, has been used for the purpose of this paper. Also, the models used in this paper has worked for us probably because of institutional inefficiencies present in the commodities markets in India. In other words, as volume starts spiking with more and more institutional investors joining the bandwagon of copper futures trading, the strategy identified by us may not work. This paper is an attempt to check impact of copper futures return on NIFTY spot return in long run as well as in short run. The study also includes relationship of lagged weekly return and monthly return between both. Also, if along with copper, all other base metal futures prices were analyzed and their collective impact on broad market index, Nifty in this case, could be better seen. This study, however, would not be within the scope of this paper.

OBJECTIVES

- (1) To identify the impact of movement in copper futures returns on NIFTY spot return in the long run as well as in the short run.
- (2) To identify the trends of copper futures price based on established models for making entry and exit decision.
- (3) To find out whether monthly return of copper futures in India can predict monthly return on NIFTY spot.
- (4) To find out whether daily return on copper futures can explain lagged daily return on NIFTY.

RESEARCH METHODOLOGY

Sample: Copper futures daily return data from Multi Commodity Exchange (MCX) are collected for almost 7 years. The copper futures price used is the near month futures price. NIFTY daily return data from National Stock Exchange (NSE) are collected for the period of almost 7 years. The daily closing price is used in case of NIFTY.

Type of Data: Secondary data is used for the purpose of study. Data are collected from the websites of MCX and NSE India.

Period of Study: 3rd July 2013 till 26th November 2020.

Sample Size For the purpose of analysis, daily price of near month copper futures has been obtained since July 2013 to November 2020 as also the daily closing price of NSE NIFTY during the same period. The number of data sets for copper futures price is somewhat more than that of NIFTY as commodities trading in India observes different trading calendar. In order to bring apple to apple comparisons, data for those periods when either NSE India or MCX India was not trading, was removed. Total 1778 observation for both copper futures return and NIFTY as well are taken into consideration during the period of study.

Statistical tools: Skewness, Kurtosis, coefficient of correlation, regression, Dicky fuller test and simple Relative Strength Indicator (RSI).

Limitations of the study

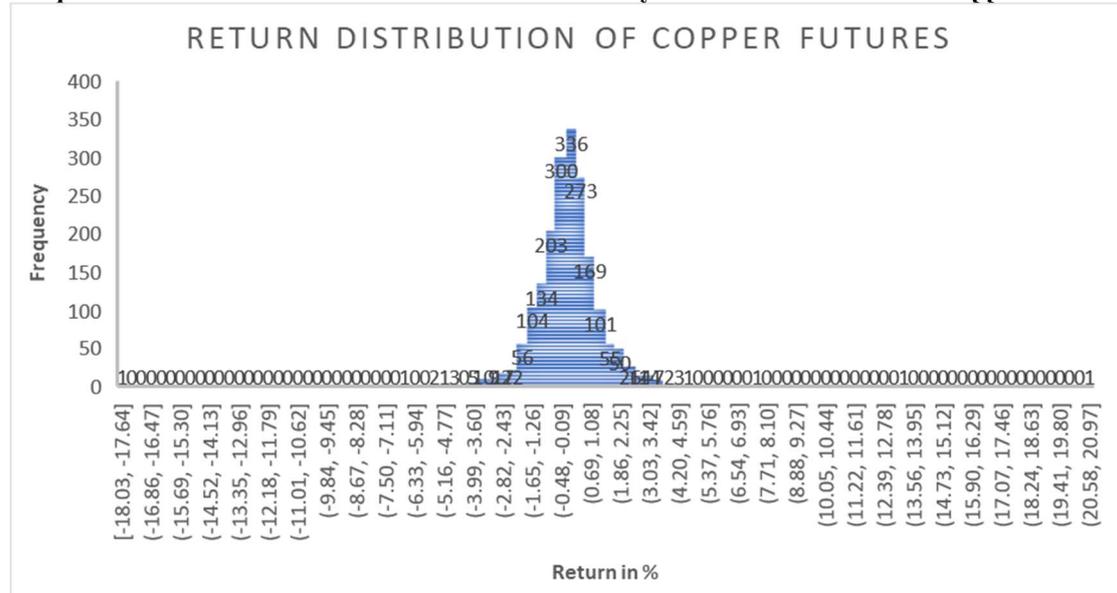
The study is only limited to one commodity i.e., Copper futures traded at MCX India and one index i.e., NIFTY. The number of observations is different for both NIFTY and Copper futures; this is due to the fact that commodities in India has been seen to have followed different calendar for trading whereas stock market (NIFTY in this case) trades only five days a week excluding national holidays. The study has not taken into consideration the factors that affect price movement in case of copper futures and NIFTY. For example, it is quite possible that copper futures prices are affected by movement of Rupee versus dollar as metal prices are decided in international market. But, for the sake of keeping it simple, we have not taken into consideration the movement of currencies that may affect prices of copper futures.

DATA ANALYSIS

This paper is an attempt to check whether copper does influence at best, or contributes at a minimum to the rally of NIFTY index.

The daily log return of copper futures was used in the study and it can also be viewed form the below-mentioned graph that the returns are normally distributed. The graph below shows the distribution.

Graph 1 – distribution of daily return of copper futures

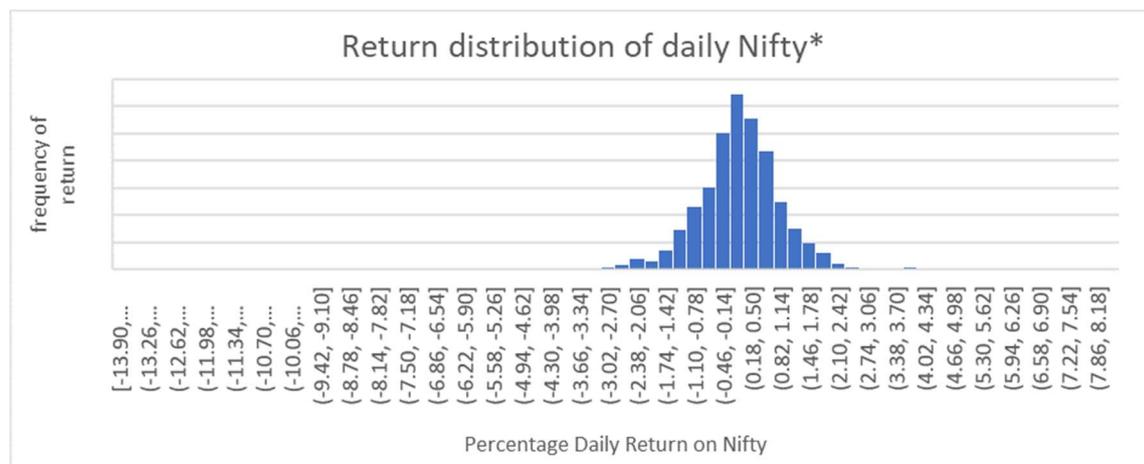


Source: www.mcxindia.com

As it is evident from the Graph-1, as shown above, the range of returns for copper are spread from -18.03 to 20.97%, however the mean of the return is close to zero, which is again in line with market expectations over a long period of time. Also, the returns are normally distributed which shows that risk-based model such VAR etc. can easily be used for margining of futures trade.

The daily log return of NIFTY Spot was used in the study and it can also be viewed form the below-mentioned graph that the returns are normally distributed. The graph below shows the distribution.

Graph 2 – distribution of daily return of NIFTY Spot



Source: www.nseindia.com

As it is evident from the Graph-2 as shown above, the range of returns are spread from -13.9% to 8.4%, however the mean of the return is close to zero, which is again in line with market expectations over a long period of time. This further validates an important assumption of all risk-based models that returns are normally distributed with zero mean and one standard deviation. The following is the summary of the data used:

Table 3: Summary Statistics of Daily Return-Copper Futures & NIFTY Spot

Variable	Observations	Mean	Std. Dev	Min Return	Max Return
Copper Futures Daily Return	1922	0.014%	1.382	-18.03 %	20.85 %
NIFTY Spot Daily Return	1831	0.044%	1.11	-13.9%	8.4%

Source: Calculated using STATA Software

Interpretation: In case of both NIFTY Spot and Copper Futures, the mean returns are not significant at 95% confidence. However, unlike in case of copper futures, the range of the daily return is less in either direction i.e., it is between minus 13.9 percent to positive 8.4 percent, whereas in case of copper futures the range is between negative 18.03 percent to over 20 percent. It can, therefore, be said that extreme returns are more likely in case of copper futures than NIFTY or the process of price discovery is better in case of NIFTY than it is in case of copper futures.

To check normality of daily return of copper futures and NIFTY Spot return, Skewness and Kurtosis tests are run using STATA software. The results are summarized in a table as under:

Table 4: Skewness and Kurtosis test for normality

Skewness/Kurtosis tests for normality				-----Joint-----	
Variable	Observation	Pr (Skewness)	Pr (Kurtosis)	Adj chi2(2)	Prob>chi2
Copper Futures Daily Return	1922	0.0000	0.0000	0.0000
NIFTY daily return	1831	0.0000	0.0000	0.0000

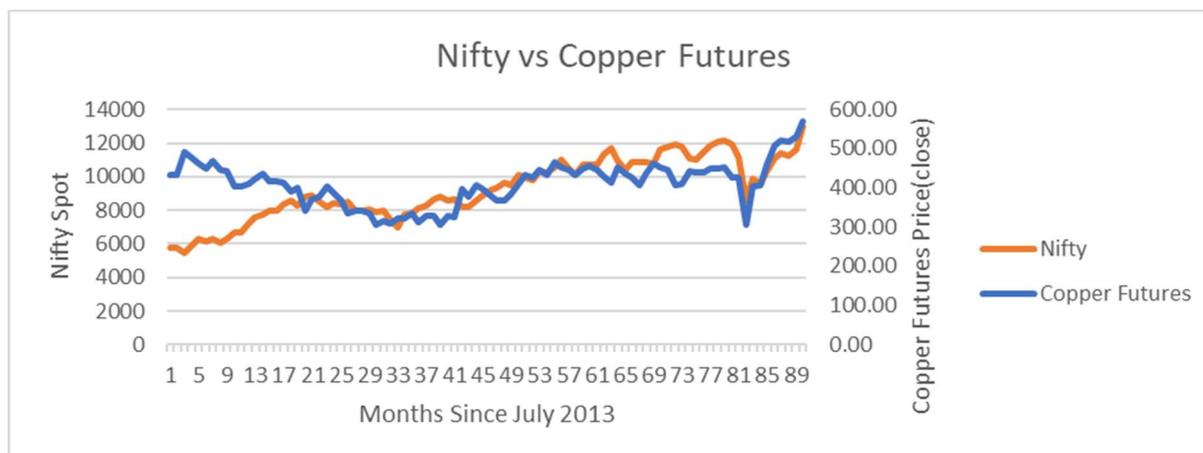
Source: Calculated using STATA Software

Interpretation: As can be seen from Table-2, the returns are perfectly normal with almost zero probability of skewness and kurtosis and a very low chi square for joint test of non-normality, in case of copper futures. The mean NIFTY return over seven years is close to zero with standard deviation of close to one; this way the distribution of NIFTY daily return to is very close to standard normal distribution. It also supports our premise that market for Nifty is very efficient.

CORRELATION ANALYSIS

The graph below depicts the monthly return of copper futures listed on MCX India and that of NIFTY of National Stock Exchange of India at Mumbai.

Graph-5: Monthly Price of NIFTY and Copper Futures Since July 2013 to Nov 2020



Source: www.nseindia.com

The Graph-5 indicates different movement for both Nifty Spot and Copper Futures during the first twenty-one months since July 2013, however, this relationship reverses subsequently and both the variables move in lockstep. During initial period prices of copper futures are declining whereas the prices of Nifty Spot are rising. Somewhere around 29th month onwards, both Nifty and Copper Futures are rising in lockstep till 81st month when there is some decline in both Nifty and Copper Futures, however, they follow each other almost all the time.

At the very basic level, correlation is calculated between daily copper futures return and daily NIFTY spot return and also the lagged NIFTY spot and weekly copper futures return and weekly NIFTY return. The result is summarized in the following table.

TABLE 6: Correlation between Copper Futures returns and NIFTY Spot returns

Variable	Daily copper futures	Weekly Copper Futures	Lagged NIFTY Weekly Return	Monthly NIFTY Return
Daily NIFTY Return	0.011	---	----	---
Lagged NIFTY Return	0.012			----
Weekly NIFTY Return	-----	0.086		----
Weekly Copper Futures	-----	----	-0.0616	----
Monthly Copper Return				

Source: Calculated using STATA software

Interpretation: The correlations between copper futures return and NIFTY return, whether daily, weekly or lagged weekly is very low indicating that copper's movement may not be affecting or contributing to return in NIFTY. When correlation of copper weekly return is calculated with one period lagged weekly return of NIFTY, the result is a low negative correlation. Once again, this shows that both copper and NIFTY are driven by different drivers of economy. The analysis finds that in the short run there is a small positive correlation of 0.06 in the last one year when both copper and NIFTY have returned positive money to investors.

REGRESSION ANALYSIS

To find out whether monthly return of copper futures in India can predict monthly return on NIFTY spot, regression analysis is performed using following equation:

$$Y_t = 0.841 + 0.225X + \epsilon_t \dots\dots\dots(1)$$

Table – 7: Summary of Regression between monthly NIFTY return and copper futures return

Monthly NIFTY Return	Coefficient	Std. Error	t value	P>t	95% Conf Interval	
Monthly copper futures return	0.2247	.07302	3.08	0.003	.0795556	.3698505
constant	.8411777	.5215752	1.61	0.110	-.1955094	1.877865

Source: Calculated using STATA software

Interpretation: The relationship between the two variables of copper futures and NIFTY, using monthly return figures, shows that every gain or loss in copper futures gets reflected in NIFTY return by a factor of 0.2247. The value of this coefficient is very significant even at 1% significance level. The constant of the regression, however, is not significant even at 10% of significant.

Table – 8: ANOVA -Monthly Copper Futures return & NIFTY return.

Source	SS	Df	MS	No of observations	89
Model	228.818183	1	228.818183	F(1, 87)	9.47
Residual	2102.56256	87	24.1673858	Prob > F	0.028
Total	2331.38075	88	26.492963	R-Squared	0.0981
				Adj R-squared	0.0878
				Root MSE	4.916

Source: Calculated using STATA software

Interpretation: The low R-squared of the regression shows that only around 10% of the variation in monthly NIFTY Spot return is explained by monthly return of copper futures. The p value of the test, however, is significant at 5% level. This should not be surprising as copper is just one metal and Nifty being the broad market index comprise almost all activities of economy.

UNIT ROOT TESTS

Unit root tests are tests for stationarity in a time series data. A time series has stationarity if after a shift in time doesn't cause a change in the shape of the distribution; unit roots are one cause for non-stationarity. Out of many available tests, The Dickey Fuller Test (sometimes called a Dickey Pantula test), is used which is based on linear

regression. Serial correlation can also be an issue. Data are checked for the unit root problem in both return on copper futures and NIFTY Spot and no issue was found of unit root.

The result using data for 88 monthly return of copper futures and NIFTY Spot returns is reproduced below:

Table 9: Dickey Fuller test for Unit Root

Copper Futures Monthly Return	Test Statistic	1% Critical Value	5% critical value	10% Critical Value
Z(t)	-12.385	-4.066	-3.462	-3.157
Mackinnon approximate p-value for Z(t) =				0.0000
NIFTY Monthly Return	-9.625	-4.066	-3.462	-3.157
Mackinnon approximate p-value for Z(t) =				0.0000

Source: Calculated using STATA software

Interpretation: There is no probability of unit root in monthly copper futures return at 1% significance level and the same is true for NIFTY Spot monthly return. It means data used in the analysis can safely be used for the purpose of regression without bothering about spurious relationships between the two variables.

Table 10: Time series regression coefficients of monthly Copper Futures return and monthly NIFTY Spot return

Monthly Copper Futures Return	Coefficient	Std. Error	t	P>t	95% confidence	Interval
L1 of monthly copper futures return	-1.290099	.1041672	-12.38	0.000	-1.497212	-1.082987
Trend	0.0389476	0.0292788	1.33	0.187	-0.0192664	.0971616
constant	-1.360786	1.4969	-0.91	0.366	-4.337024	1.615452

Source: Calculated using STATA software

Interpretation: The table above shows that only lagged one monthly copper futures return is significant at even at 1% level of significance. Both the trend and constant terms are not significant.

Table 11: Time series regression coefficients of monthly NIFTY Spot return

Monthly NIFTY Return	Coefficient	Std. Error	t	P>t	95% confidence	Interval
L1 of monthly NIFTY return	-1.066213	.1107808	-9.62	0.000	-1.286475	-.8459514
Trend	-0.0093581	.0219669	-0.43	0.671	-.0530343	.0343181
constant	1.395036	1.134027	1.23	0.222	-.859714	3.649787

Source: Calculated using STATA software

Interpretation: The table above shows that only lagged one monthly NIFTY return is significant at even at 1% level of significance. Both the trend and constant terms are not significant. Hence, based on the result so obtained, it can be said that both the time series data of monthly return on copper futures and NIFTY Spot are stationary.

And, the monthly return of copper futures does explain the return on NIFTY, of course, the explanatory power of the regression is limited to 9.81 percent. Considering, however, the influence of so many industries and hence so many commodities and services on Nifty, this does indicate a strong influence of copper futures on Nifty.

MOMENTUM IN COPPER FUTURES

The next step is to find out whether there is momentum in the copper futures. In other words, if in short term there is a trend in the price, whether that trend can be used by traders in short, medium or long run. To get to this, simple Relative Strength Indicator (RSI) based on daily copper futures prices is calculated. In order to keep it very simple, the RSI was neither smoothed nor was rolling RSI used. The entire data was segregated into 14days' period and based on the following formula RSI was calculated from the closing copper futures prices³.

$$RSI = 100 - 100 / (1 + \text{positive average return} / \text{negative average return}) \text{-----}(1)$$

The RSI, by its very design, can have maximum value of 100 and minimum value of 0. However, what is interesting for a trader is whether it is above 70 or below 30. Values above 70 are considered to be overbought and theoretically no profit is possible at this level of price, if one is to initiate a buy trade, however, by shorting the futures one can make money. Values below 30 are considered to be oversold and it offers great opportunity to initiate long position in the stock/commodity

The Table 12 below gives summary of RSI calculation using above-mentioned formula:

Table 12 Summary of RSI

Period	RSI	Remarks	Period	RSI	Remarks	Period	RSI	Remarks
1	48.03	Neutral	47	27.21	Oversold	93	68.93	Neutral
2	68.83	Neutral	48	27.64	Oversold	94	15.87	Oversold
3	87.78	Overbought	49	56.06	Neutral	95	43.78	Neutral
4	45.34	Neutral	50	26.91	Oversold	96	30.05	Neutral
5	55.49	Neutral	51	73.36	Overbought	97	62.04	Neutral
6	26.47	Oversold	52	71.96	Overbought	98	77.71	Overbought
7	67.52	Neutral	53	29.54	Oversold	99	45.48	Neutral
8	30.12	Neutral	54	53.89	Neutral	100	42.96	Neutral
9	50.47	Neutral	55	38.06	Neutral	101	34.98	Neutral
10	77.37	Overbought	56	52.59	Neutral	102	57.67	Neutral
11	30.45	Oversold	57	38.98	Neutral	103	20.73	Oversold
12	29.24	Oversold	58	71.18	Overbought	104	67.25	Neutral
13	61.74	Neutral	59	61.91	Neutral	105	68.65	Neutral
14	7.55	Oversold	60	36.14	Neutral	106	63.53	Neutral
15	51.80	Neutral	61	33.95	Neutral	107	28.41	Oversold
16	55.58	Neutral	62	86.12	Overbought	108	60.87	Neutral
17	55.87	Neutral	63	32.21	Neutral	109	32.16	Neutral
18	51.61	Neutral	64	77.60	Overbought	110	25.82	Oversold
19	49.48	Neutral	65	83.34	Overbought	111	52.65	Neutral
20	82.06	Overbought	66	62.24	Neutral	112	68.12	Neutral

³ <https://www.investopedia.com/terms/r/rsi.asp>, formula taken from Investopedia website.

21	46.69	Neutral	67	28.73	Oversold	113	57.16	Neutral
22	39.93	Neutral	68	67.19	Neutral	114	51.54	Neutral
23	47.45	Neutral	69	47.45	Neutral	115	62.86	Neutral
24	42.11	Neutral	70	59.79	Neutral	116	30.03	Neutral
25	43.56	Neutral	71	21.84	Oversold	117	44.82	Neutral
26	53.53	Neutral	72	43.50	Neutral	118	55.20	Neutral
27	43.53	Neutral	73	57.81	Neutral	119	31.11	Neutral
28	55.85	Neutral	74	38.04	Neutral	120	59.89	Neutral
29	8.74	Oversold	75	52.49	Neutral	121	52.10	Neutral
30	28.43	Oversold	76	58.53	Neutral	122	62.76	Neutral
31	69.34	Neutral	77	65.63	Neutral	123	31.09	Neutral
32	58.50	Neutral	78	78.88	Overbought	124	45.96	Neutral
33	61.74	Neutral	79	76.61	Overbought	125	13.87	Oversold
34	45.31	Neutral	80	40.97	Neutral	126	55.85	Neutral
35	76.52	Overbought	81	75.71	Overbought	127	48.66	Neutral
36	25.35	Oversold	82	55.33	Neutral	128	60.76	Neutral
37	25.80	Oversold	83	41.11	Neutral	129	79.60	Overbought
38	80.48	Overbought	84	40.93	Neutral	130	77.29	Overbought
39	24.41	Oversold	85	93.57	Overbought	131	80.96	Overbought
40	25.49	Oversold	86	30.96	Neutral	132	44.18	Neutral
41	27.24	Oversold	87	36.48	Neutral	133	63.18	Neutral
42	30.74	Oversold	88	65.43	Neutral	134	53.76	Neutral
43	48.25	Neutral	89	34.68	Neutral	135	48.11	Neutral
44	57.43	Neutral	90	57.77	Neutral	136	52.29	Neutral
45	44.47	Neutral	91	62.03	Neutral	137	74.95	Overbought
46	59.35	Neutral	92	52.90	Neutral			

Source: Calculated using STATA software

*Note:*¹ The last period for which RSI was calculated only consisted of 11 days as opposed to 14 days in case of all other time period.

Interpretation: The RSI based analysis has shown results which are summarized below:

- Out of the 137 periods of 14 days each^{ix} for which RSI were calculated trading signals are generated on 40 occasions. On these 40 occasions when trading signals are generated to buy or sell, trade reversals or immediate profit booking opportunities arise in the very next period in 31 instances. This indicates that there is huge opportunity to make money in copper futures for speculators based on technical analysis.
- In seven instances, a trader would have to wait for two periods of 14 trading days each to make money, however, the opportunities are certain.
- In only three instances, a trader would have to wait for more than two periods of 14 trading days each to make money but opportunities have been there after all.
- All signals to profit have resulted in clear profit; the amount of profit would depend of when one made exits and what was the invested capital.
- No trading decisions have been based for the period when the RSI was in neutral zone, though it is possible to make money during those periods also.

Overall, copper futures trading in India at MCX Exchange exhibit momentum trading gains as is evidenced in many other findings in commodity market.

FINDINGS

The study reveals that extreme returns are more likely in case of copper futures than NIFTY. As a corollary, this means short term trading, if done with due care and skill, could be more profitable in case of copper futures than a broad market index such as NIFTY. This could be probably due to the popularity of trade and also because of less penetration of retail in commodity market in general and copper futures in particular. Another plausible reason for NIFTY displaying more mature statistical figures could be due to the large number of trades going to NIFTY. The average daily volume of NIFTY spot transactions is Rs. 13416 Crore, whereas the corresponding figures for copper futures is little over Rs. 2960 Crore.

One inference of this is price discovery is happening quicker in case of NIFTY trades than in case of copper futures, however, as more and more money chases this commodity the return distribution will be mimicking NIFTY very closely.

As Copper is not as crowded a trade as trading on NIFTY Futures, etc., hence, predictions based on simple RSI can give good return in a very short period of time. As more and more participants find out this anomaly, this free lunch could disappear in future.

Since commodities represent around 6% weight on NSE NIFTY, copper explaining 9.81 percent of NIFTY return could be an authentication of fact that return on copper could be an early indicator of return on broader market. Of course, in short run, there are many triggers for market moves, hence, any one factor explaining the entire index may be a far cry.

SUGGESTIONS

Although more researches are needed to establish whether most, if not all, commodities trading in India exhibit inefficiencies during some of the times. We have observed that commodity futures in general, copper futures trades in particular, is not widely traded as NIFTY Futures. There have been institutional rigidities in commodities market in India as we have pointed out, however, going forward this may not be the case. This study is helpful for traders who want to make quick money in not so efficient market. The market for copper futures is not so efficient when compared with the NIFTY index or probably any other widely tracked index. A trader's mindset is to exploit any inefficiency in the market and make quick money. On the basis of our findings, we notice that copper is not a crowded trade unlike NIFTY, hence, predictions based on simple RSI model, as we have used, can give good return in a very short period of time. As a corollary to findings, the deeper a market is-NIFTY in our case, the less volatile it is compared to other market (copper in our study) which is not so liquid. In the early stage of introduction of a product, the market for it is not so liquid and there are good opportunities to generate alpha. However, as more and more participants are drawn towards this market, the abnormal return disappears. For regulators, it is a reminder that unless market for a product is deep and very liquid, abnormal return will continue to accrue to some sophisticated trader at the cost of blind speculators. The results of above study are in line with the findings of Dimitris Kenourgios and Aristeidis Samitas (2010) who finds that the commodity market is not efficient.

FURTHER SCOPE OF STUDY

The same study can be performed using other precious metals and different indices like SENSEX, iCOMDEX, to name a few. The impact of copper futures price in international market and volatility in copper futures prices in India can also be measured. Also, the return on copper futures and return of some of the metal stocks listed on Indian Exchanges can be a source of further interesting study. Of late, however, many funds have been allowed to trade in commodity futures in India by SEBI – the capital and commodity market regulator in India, it will be interesting to see whether entry of sophisticated players crowd out the free lunch which is noticed from the above study using simple relative strength indicator (RSI). This was also the situation in equities derivatives market in

early 2000s when trades were not liquid and FIIs/FPIs were not very active in derivatives trading. Things, however, changes subsequently. The equity derivatives market as on date is mostly dominated by institutions and foreign players.

CONCLUSION

The results show that daily returns, weekly returns of copper futures are not significantly correlated with corresponding figures for NIFTY. Even the lagged return of NIFTY is not correlated with return on copper futures. The study reveals significant, albeit low, correlations between monthly return of copper futures and monthly NIFTY return. In other words, monthly returns of copper futures could be an early indicator of rally in broader market, however, we don't have sufficient evidence to conclude it. Since money can easily be made on simple RSI models/techniques without waiting for good economic news to impact copper, the market for copper seems to be inefficient or at best, weakly efficient. Like many commodities, copper too exhibit gains based on momentum-based strategies such as RSI in our paper. As has been pointed out in foregoing paragraphs, these abnormal returns are predictable probably because copper in India is not very crowded trade. By crowded trade, we mean trades that are dominated by all sorts of market participants including day traders, speculators, hedgers, producers, suppliers, large institutional funds, retail investors, etc. We do believe, however, as regulations are being made more flexible and entry of institution in commodities will likely happen soon, these abnormal returns will vanish. However, it has not happened as yet and may not happen for quite some time to come for various reasons. NIFTY index, being a barometer of stock market, is less volatile and moves in lower range compared to less liquid contracts such as copper futures, which has wide dispersion and range of return. NIFTY with a history of approximately a quarter century behaves like a big brother to copper which has miles to go as far as market maturity is concerned. The last one year of our study has contained figures of Covid period both in India and across continents, however, our findings have not been impacted. What it means, therefore, is markets behave in their own way, irrespective of short-term crises impacting main street.

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